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Draft Memorandum on Defense of Warren Commission by Dr. Luis Alvarez

1. Introduction

The CBS News broadcast, "The Warren Report," of 25 June 67 made use of the research of Dr. Luis Alvarez, of the Lawrence Radiation Laboratory, whose work was seconded by Charles Wyckoff of Edgerton, Germeshausen and Grier, a photographic firm. The enclosed correspondence, plus the transcript of the CBS presentation (not reproduced here), show clearly that the statements and conclusions given by CBS to its audience are surprisingly different than the inferences to be drawn from the fathers of the research.

The calculations herein, where not drawn from the Warren Report, were done with a West plat map, a yardstick, and my fingers. More accurate statistics are cordially invited from someone with better materials, or more fingers.

2. Alvarez's methodology

He examined the frames from the Zapruder film printed in the Commission's volume eighteen. He states:

The startling thing is that there were three "trains of pulses", each lasting almost exactly one second, with a definite starting pulse, and a definite final pulse. One of the sets of pulses started at Frame 313, confirming the method.

As his chart shows, the trains of pulses began at Z181, 220 and 313.

3. Alvarez's conclusions

The conclusion I drew then, and the one with which Mr. Wyckoff agreed, was that each shot set the neuromuscular system of Mr. Zapruder into oscillation, and that it took approximately one second for him to damp out the oscillations.

There were three, and only three, shots. They probably occurred at Z177, 217 and 313.

4. Charles Wyckoff

He examined the Archives copy of the film, and found no oscillations prior to the published frames attributable to a startle

reaction by Zapruder. He found trains of oscillations beginning at Z190, 227 and 318, and concluded that these represented Zapruder's reactions to shots at Z186, 222-223 and 313.

5. Limitations of the method: conflicts between Alvarez and Wyckoff

Analyzing the Zapruder film by reference to blurred frames should be simple enough. Either a frame is blurred or it is not. The presence or absence of a "definite starting pulse" seems capable of easy ascertainment. It is with confusion, then, that one notices the complete lack of agreement between Alvarez and Wyckoff. Alvarez's first pulse begins at Z181, Wyckoff's at Z190. Alvarez's second begins at Z220, Wyckoff's seven frames later. They are even five frames apart on the Z313 shot. So either Wyckoff missed up to twenty-one frames containing blurs, or Alvarez saw blurs that are not there, or both.

6. The forty-two frame limitation

If FBI firearms expert Robert Frazier was correct, the Mannlicher-Carcano allegedly used by the lone assassin could not be fired faster than once every 2.3 seconds. With Zapruder's camera running at a speed of 18.3 frames per second, the minimum time between shots from the Carcano would be represented by 42 frames of the Zapruder film.

It should come as no surprise to learn that, if either Alvarez or Wyckoff is correct as to the placement of the first and second shots, there was more than one assassin. Alvarez's second shot is only 40 frames after his first, and Wyckoff's is only 36 to 37. The only way the blur-analysis could produce a single shooter is for Alvarez to be correct about his first shot, and for Wyckoff to be correct in his outside guess as to the second (Z223 instead of Z222.) This is hardly a safe assumption.

Remember also that time is needed to track a moving target (either 6.1 frames or a full 18.3, according to the ambiguous statement by Frazier).

7. Characteristics of trains of pulses, according to Alvarez

a. First train

This one is about twenty-one frames long, which is close to his "almost exactly one second" finding. Note, however, that to reach such a length it is necessary to include in the train a four-frame gap between Z185 and about Z189. With these steady frames and the preceding oscillations removed, the train is only about fourteen frames long, considerably less than a second. We are asked to believe that Zapruder, whose neuro-

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muscular system allegedly took about a second to control, could produce four frames of calm panning in the middle of a marked startle-response.

Note also that Alvarez misplaces the gap between the branches of the tree between the sixth floor window and the limousine. If a shot was fired at Z177 from that position, it went into the foliage.

Alvarez thinks this was the shot that missed. It certainly did. His suggestion that it may have lodged in the tree was disproved when a CBS metal detector failed to find any trace of it. So this bullet not only missed the tree and the President, but also the limousine and Elm Street. For a shot from the sixth floor window fired at this point, or a fragment of such a shot, to have hit the far curb of Main Street and to have caused James Tague's wounds, it would have had to ricochet wildly around Dealey Plaza. The same objections apply to a missed shot at Z186.

b. Second train

It is difficult to understand why Alvarez would consider this to be a train of pulses with a definite one beginning and ending it. Rather, it is four separate and distinct pulses, with a gap between each two of several frames. It is not only totally unlike either of the other trains representing shots, it is much weaker than the "weak train" allegedly representing a siren. The characteristics of the pulses in this "train," especially the last two, bear less resemblance to the trains assigned to shots than they do to the "background noise" on the third line of the chart.

c. "Weak train"

This one is about eleven frames long. Alvarez thinks it is due to the siren on the Secret Service followup car. For a loud, unexpected noise of extended duration, therefore, Zapruder brought his neuromuscular system under control in a little over one-half second.

Alvarez cites as corroboration his finding that the President's limousine began slowing a few frames after the beginning of this train. This, says Alvarez, would be the "natural reaction of any driver of the President's limousine" to hearing a siren. Such a statement could be made only with knowledge of the reaction patterns of Secret Service drivers in general, and Greer in particular.

d. Final train

Alvarez states that each train representing a shot is "almost exactly one-second long." It would be interesting to know how

he so concludes for this train, since, as his chart shows, Zaprunder was still swinging back and forth at the conclusion of the published frames. Note also the gap at approximately Z315-317 and the possible gap at about Z326-329.

8. Placement of shots: general principles

a. Alvarez-Wyckoff rules of thumb

Wyckoff postulates a four- to five-frame gap between the firing of each shot and the beginning of each train of oscillations. Alvarez states the lag to be one-third of a second, but then retreats from it. His chart shows a lag of four frames for the first shot, three for the second, and none at all for the third.

b. Velocity of bullets

This is the first necessary factor not mentioned by Alvarez or Wyckoff. Bullets do not strike as soon as they are fired. They take time to travel to their targets.

c. Velocity of sound

This is the second factor influencing the relationship of blurs to shots. The exact determination of the velocity of sound in Dallas at 12:30 pm on 22 Nov 63 would depend upon temperature and humidity. Under normal conditions, however, the velocity of sound at sea level is 1087.42 feet per second.

d. Latency of human startle reaction

According to Jones and Kennedy, "An Electromyographic Technique for Recording the Startle Pattern," 32 J. Psych. 63 (1951) the startle pattern is "an immediate, involuntary response to a sudden, intense stimulus. It is easy to elicit; it is of universal occurrence; and it involves the whole organism in greater or less degree." It begins with an eye-blink, which is followed by a widening of the mouth, and then a forward head movement. The wave then may travel throughout the body. The gross musculature returns to its prestartle position quite soon -- .3 to 1.5 seconds, say Landis and Hunt, THE STARTLE PATTERN (1939), .2 to .5 seconds, say Jones and Kennedy, as little as .3 second, say Woodworth and Schlosberg, EXPERIMENTAL PSYCHOLOGY (1954) -- usually with no residual activity.

Naturally, the lag between the receipt of the stimulus and the response varies between individuals. Woodworth and Schlosberg, concurring with Landis and Hunt, found the mean latency of the forward head movement to be 83 milliseconds (Jones and Kennedy, in effect measuring something different, found it somewhat shorter). The spread found by Landis and Hunt was 60 to 120

milliseconds for the initiation of this movement.

9. Application of general principles to Z film.

a. Velocity of bullets

The muzzle velocity of the alleged assassination weapon was found to be about 2,160 feet per second. In one series of experiments, the average entrance velocity at 180 feet was 1,904 feet per second. At 210 feet, another series of experiments found the average entrance velocity of eleven bullets to be 1,929 feet per second.

Splitting the difference between these figures and assuming a uniform rate of loss of velocity gives a loss rate of 1.309 feet per second per foot.

b. Velocity of sound

The discharge of a firearm always produces two sounds, the muzzle blast and a shock wave. If a bullet hits, the impact produces its own sound. Bullets fired from the sixth floor window would have travelled toward Zapruder. If they struck their targets, the first sound to reach Zapruder would not have been from the TSBD, but from the impact and the narrow end of the shock wave. From a missed shot fired in the same direction, the first part of the sound reaching Zapruder would have been that part of the cone of sound emanating from the point along the bullet's path closest to Zapruder, if the bullet passed him. An early miss, in the vicinity of the tree, would have struck near the limousine, yielding essentially the same values.

c. Startle reaction

If the blurs in the film were caused by Zapruder's startle reaction, they were undoubtedly touched off by the forward head movement. Since the relevant tests were not undertaken by the Commission, we shall never know what Zapruder's exact reaction time was on 22 Nov 63. However, a reasonable guess based upon his age probably would yield a latency for the forward head movement in the upper range of the possibilities. Splitting the difference gives a figure of 100 milliseconds, representing 1.83 frames of the film.

d. Placement of shots by blur-analysis

If there were blurs from oscillations beginning at the following frames of the film:

Alvarez
181
220
313

Wyckoff
190
227
318

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the sounds reached Zapruder at these frames:

Alvarez	Wyckoff
179.16	188.16
218.16	225.16
311.16	316.16

If so, the limousine would have been the following distances, in feet, from Zapruder for shots that hit, given a velocity of sound corresponding to 59.437 feet per frame:

Alvarez	Wyckoff
145	137
112.5	107
73	72.5

Hits would have struck the car at the following frames:

Alvarez	Wyckoff
176.67	185.822
216.27	223.361
309.928	314.938

representing a distance to the sixth floor window, in feet, of

Alvarez	Wyckoff
142	156.3
178.5	186.5
262	267

The striking velocity in feet per second for bullets fired at those distances would be

Alvarez	Wyckoff
1974.122	1955.403
1926.343	1915.871
1817.242	1810.457

which would mean that it took them the following number of frames to reach the points of impact:

Alvarez	Wyckoff
1.2	1.29
1.55	1.73
2.5	2.5

So shots would have been fired at points corresponding to the following film frames:

Alvarez	Wyckoff
175.57	184.532
214.72	221.631
* see next paragraph	312.438

Alvarez's Z313 reaction, which he feels to be the result of the shock wave acting directly upon Zapruder's camera, would eliminate the startle reaction from the calculations, so that shot would have been fired at Z309.258, rather than Z307.428.

Obviously, the fatal shot did not strike the President at either Z310 (Alvarez) or Z315 (Wyckoff). The weaknesses of blur-analysis are, therefore, monumental.

9. Direction of beginning pulses

The direction of the forward head movement in the startle pattern is independent of the direction of the stimulus. One's reaction to being startled is always in the same direction.

Alvarez found the train of oscillations representing the fatal shot to be puzzling because it began with a pulse indicating that the camera had moved clockwise looking down, the opposite of the other two trains assigned to shots. He concluded that this was due to the shock wave from the bullet acting directly upon Zapruder's camera, since that bullet came much closer to Zapruder than the other two.

The first objection to this conclusion is that there were many witnesses in Dealey Plaza closer to the point of impact than Zapruder, and none of them reported feeling the shock wave. The shock wave from a bullet fired from the sixth floor window would have been appreciably stronger to them than to Zapruder. Yet none of them, not even those within the limousine itself, report such a phenomenon.

The other objection to Alvarez's conclusion is that, according to him, the motion of the camera due to the shock wave began essentially simultaneously with the impact of the fatal shot. This ignores the necessary lag between the impact of a bullet fired from the sixth floor window and the arrival of the shock wave in Zapruder's vicinity, something on the order of 1.2 frames. So if Z313 is blurred as the result of a bullet's shock wave, the conclusion is inescapable that the bullet was fired from a point much closer to Zapruder than the sixth floor window.

Note that Alvarez does not even attempt to deal with the problems arising from the beginning pulse of the "weak train," which is in the same direction as that of the train beginning at Z313. Note also that if Wyckoff is correct in ignoring the blurs prior to Z189, that train of oscillations begins the same way.

10. Resolution of separate shots

Alvarez first told Raymond Marcus that his method could not resolve shots occurring within one second of each other.

Later, he stated the refractory period to be one-half second. To Dr. Menaker, he first claimed that the response time of the human neuromuscular system was one-third of a second, thereby destroying his guesses as to the firing of the shots, as shown on his chart. He said that the pulses were about one-third of a second apart. Oh, really? Where? Not on this chart.

Challenged by Dr. Menaker, Alvarez stated that what he really meant was that one-third of a second was the characteristic time of the human neuromuscular system, and began rhapsodizing about nanoseconds and eons.

It should be obvious that there is no way at all to resolve separate shots fired closely together by means of blur-analysis. To do so would require knowledge of how long it took Zapruder to bring his neuromuscular system under control on 22 Nov 63, a fact which will remain unknown, and would require that no shots were fired closer together than whatever period this might turn out to be.

11. CBS' use of Alvarez and Wyckoff

This aspect of Walter Cronkite's extravaganza was as doctored as any other. There was not even any mention of the blur-analysis being limited to establishing, at best, only a minimum number of shots.

On the show, Alvarez mentioned only one blurred frame, Z227. According to his letters and chart, this frame occurs in the middle of a train of oscillations, not at the beginning. By happy coincidence, the frame Alvarez picked to demonstrate to the American people the validity of his method just happens to represent the beginning of one of Wyckoff's trains of oscillations. CBS did not bother to inform its audience that the two men were unable to agree on whether at least twenty-one frames were blurred.

Alvarez appeared in two short segments of the show. First, he introduced his method by use of Z227. Last, he stated that only three shots were fired. Between his appearances, Wyckoff carried the ball, contradicting Alvarez at every crucial point in the application of the theory.

12. Miscellaneous considerations

a. Thompson's critique of Alvarez

Josiah Thompson's SIX SECONDS IN DALLAS dismisses the blur-analysis by assigning blurs to the motion of the film in the camera, back and forth in relation to the lens. However, Alvarez and Wyckoff were dealing with a particular type of blur indicating motion of the camera itself. They dealt with streaks on the film, not mere clarity of image.

b. Possible Z186 shot

According to Woodworth and Schlosberg, one can, with practice, deliberately react in 140 milliseconds to sound, the most effective stimulus. Reactions such as these are simple, involving little thought or motion.

The Commission found that the President was visible from the sixth floor window for one frame, between branches of the tree. If it takes one-seventh of a second merely to react to sound, consider the complex action involved in a Z186 shot.

Someone in the sixth floor window would have to realize that a shot could be fired, make the decision to fire, calculate -- perhaps with a faulty telescopic sight -- the proper distance to lead the target, move the rifle that distance and fire, all in one-eighteenth of a second.

To state the possibility is to refute it.

c. Head snap at Z313

Some defenders of the official story have noticed what the Commission did not: that after the fatal shot the President was thrown back and to his left, as if that shot had come from the right front, rather than the right rear. Some explain it by sudden acceleration of the limousine (which did not occur that soon) or by a neuromuscular reaction.

Leaving aside the question of whether it was possible to produce a neuromuscular reaction with a brain so wounded, note that the President already is beginning to move back by Z314, a mere 55 milliseconds. This is five milliseconds sooner than the quickest head movement found in all the experiments of Landis and Hunt, and massively stronger than the short jerk forward it produces.